

LiLa – Library of Labs

Dissemination
of Remote and Virtual Laboratories
for Natural Sciences and Engineering

May 2009 – November 2011



Co-funded by the community
programme *eContentplus*

LiLa is an acronym for 'Library of Labs', an initiative of eight universities and three companies, which aims at developing an integrated platform for remote experiments and virtual laboratories.












LiLa is committed to enhancing the learning experience of science and engineering students all over Europe.

LiLa is co-funded by the *eContentplus* programme of the European Commission.

Eight European universities and three enterprises have united to work on LiLa. Each participant offers specialised expertise in one or more of the following fields:

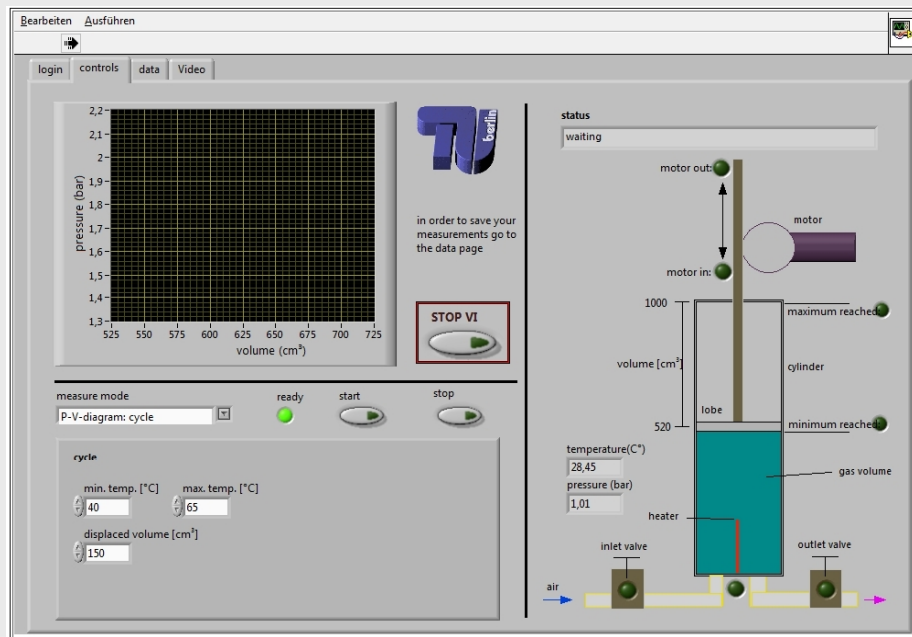
- content (virtual laboratories & remote experiments)
- access control and booking systems
- 3D modelling
- meta data development
- e-learning pedagogics



	Universität Stuttgart (Coordinator)	<i>Germany</i>
	Technische Universität Berlin	<i>Germany</i>
	Oracle Germany (formerly Sun)	<i>Germany</i>
	Technische Universiteit Delft	<i>Netherlands</i>
	Linköpings Universitet	<i>Sweden</i>
	Universität Basel	<i>Switzerland</i>
	Universidad Politécnica de Madrid	<i>Spain</i>
	Aristotle University of Thessaloniki	<i>Greece</i>
	University of Cambridge	<i>UK</i>
	Computational Modelling Cambridge Ltd	<i>UK</i>
	MathCore Engineering AB	<i>Sweden</i>

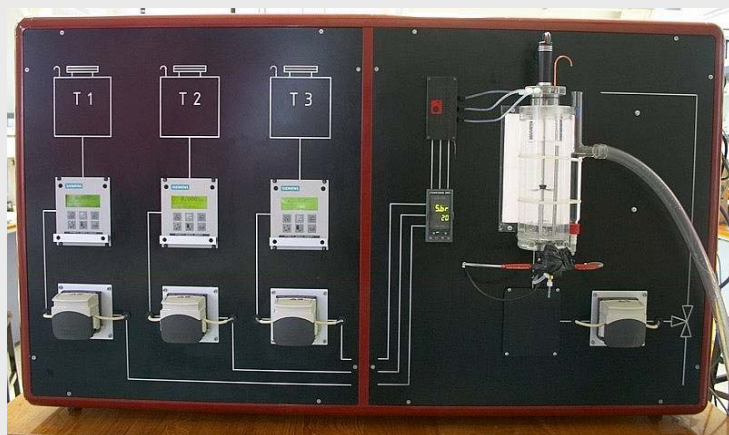
- Create a technical and organizational framework for the mutual exchange of experiments across Europe (and beyond)
- Build a repository of experiments on a central server where experiments can be retrieved
- Offer the experiments as reusable modules which can be run on local Learning Management Systems as well as on the LiLa portal
- Equip the experiments with describing data (metadata) and integrate them into library catalogs, thus making them retrievable in library systems
- Make the experiments accessible via an access control and a booking system that allows reservation of experiments by lecturers and booking of experiments by students
- Facilitate the creation of courses and allow users to supplement and change courses
- Integrate the LiLa experiments into a framework that fosters collaboration between students and discussion on experiments
- Disseminate the LiLa network across Europe (and beyond)

In a remote lab students control real (physical) equipment via the internet and investigate real objects.

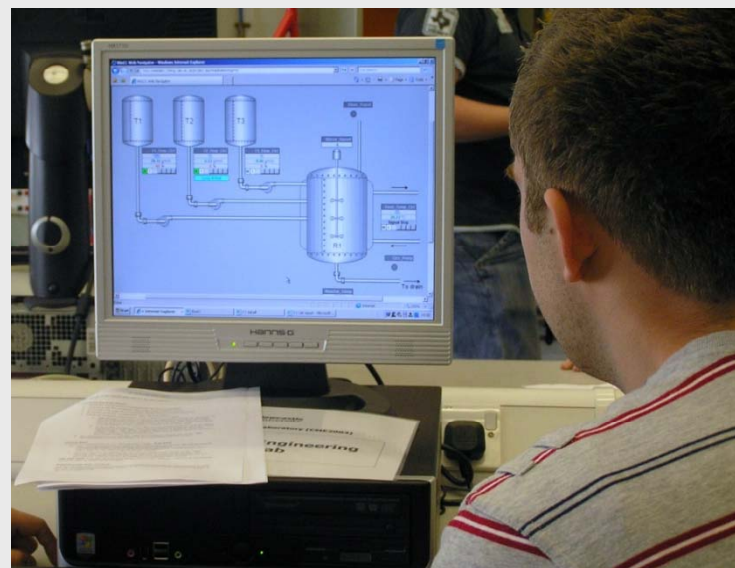


The Cambridge Reactor Weblab

The reactor – a key unit in many chemical plants – can be fed with three liquids. The reaction is monitored and controlled remotely...



... for instance, at the University of Newcastle.



Virtual laboratories are simulation environments that model physical processes on the computer. They are often combined with real experiments.

The screenshot shows a web browser window titled "Experimente zum Ferromagnetismus - Mozilla Firefox". The address bar shows the URL <http://www.rus.uni-stuttgart.de/dienste/multimedia/labor/beispiele/ising/>. The page content includes:

- Getting Started**: externen F-eld B: Sind die Spins parallel zum F-eld ausgerichtet, ergibt sich ein Energiebeitrag von $-B$, ansonsten von $+B$.
- Spontane Magnetisierung**: Das Ising-Modell zeigt eine Eigenschaft namens "Spontane Magnetisierung", bei der die Spins sich in Abwesenheit eines äußeren Feldes von selbst in eine zufällige Richtung ausrichten.
- Durchführung**:
 - Klicken Sie mit der linken Maustaste auf das "CLS" Symbol auf der rechten Seite um den Bildschirm zu löschen.
 - Stellen Sie sicher, dass die Temperatur vermöge des Schiebers unterhalb des Experimentes auf einen Wert kleiner als 50 eingestellt ist.
- Stellen Sie sicher, dass das äußere Magnetfeld vermöge des Schiebers unterhalb des Experimentes auf einen Wert kleiner als 50 eingestellt ist.

The interface features a central "SpinPlane" window displaying a 2D lattice of spins (yellow and black pixels). Below it are sliders for "temperature" (set to 32), "field" (set to 0), and a "magnetization" plot showing a value of $3,71E-2$. A toolbar on the right contains various control icons, including a "CLS" button.

Footer: Applet Ising Applet started

The friction simulator at Nano-World (University of Basel) enables students to simulate friction phenomena on an atomic scale.

Simulator Applet

Save Image Save Data XXXXXXXXXX Change Colors

ms p/L 0.0 20.0 159.0 1.0 25.0

3 (Friction forward) Approach Withdraw

Currently, the LiLa portal at www.library-of-labs.org contains

- 41 remote experiments and
- 218 virtual laboratories

in the following fields:

Physics	150
Chemistry	6
Engineering	7
Mathematics	75
Computer Sciences	21



The LiLa portal:

- Explore, search and run experiments.
- Rate and comment them.
- Download experiments to your computer, upload them to your local Learning Management System
- Upload new experiments.

<http://www.library-of-labs.com>

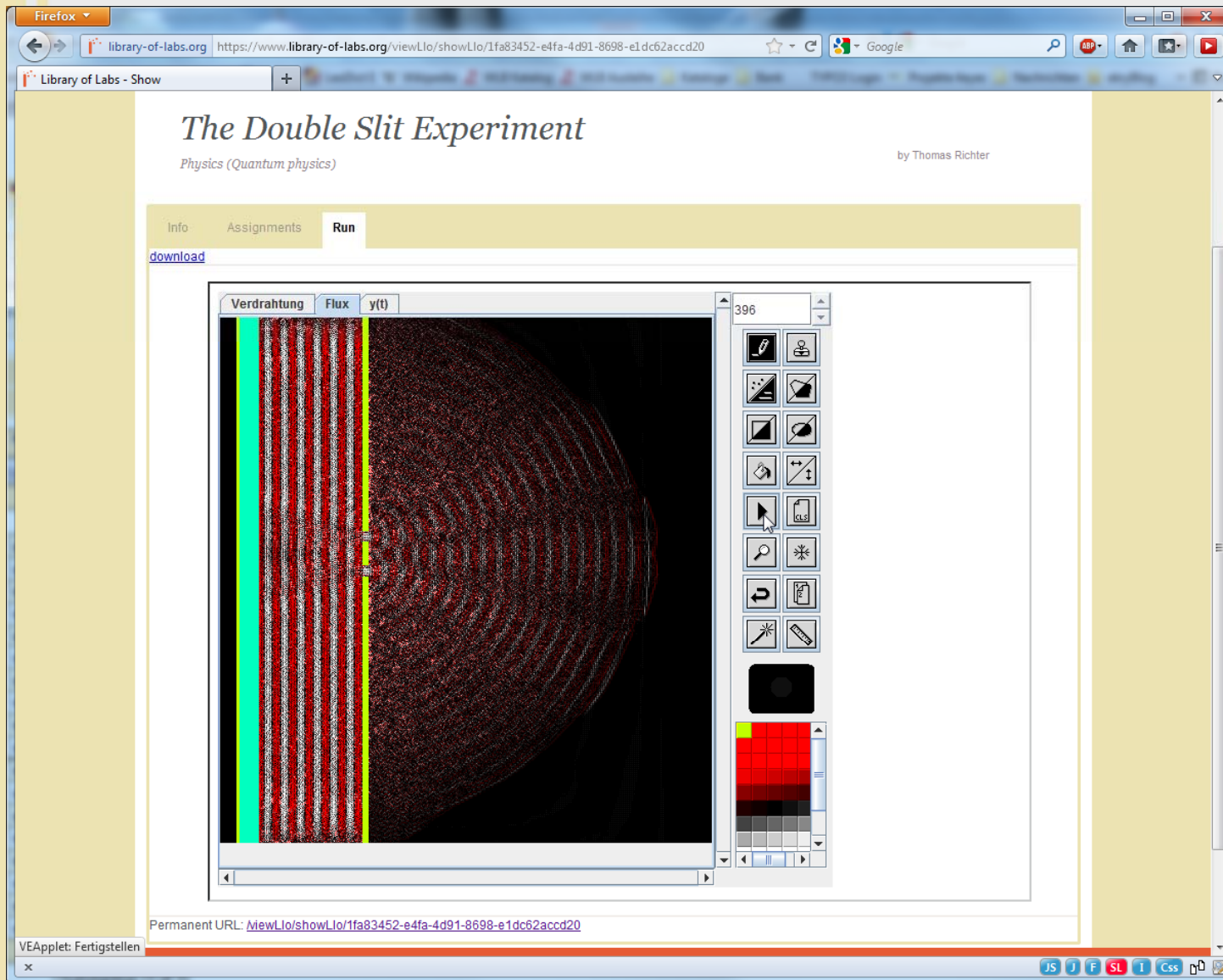
Click on „Explore LiLa“ to browse experiments by scientific field or content type, or to find experiments by searching for terms like name, author, keyword, etc.

The screenshot shows the LiLa Library of Labs 1.5 search results page. The header includes the LiLa logo and navigation links: Start, Explore, Contribute, Register, and Sign in. The breadcrumb trail is Home > Explore > Search Results. The left sidebar contains a 'Filter' section with 'Content Type' (Experiments: 15, Resources: 3) and 'Scientific Field' (Mathematics: 4, Physics: 14). The main 'Results' section shows a search for 'gas' with three results:

- The Ideal Gas** (24-Nov-2011): This is an instruction/manual on how to run experiments on the ideal gas in VideoEasel. (0 likes)
- Gas Properties** (18-Mar-2011): Pump gas molecules to a box and see what happens as you change the volume, add or remove heat, change gravity, and more. Measure the temperature and pressure, and discover how the properties of the ... (0 likes)
- HPP Gas with Borders** (29-Jul-2011): This virtual experiment implements a lattice gas whose particles run into diagonal direction and reflect on each other and container walls. It is completely deterministic and thus also time-reversal ... (0 likes)
- HPP gas with borders and marked particles** (04-Aug-2011): This is a simulation of a lattice gas of particles only being able to move in diagonal directions. Particles can reflect on walls and on each other. In this specific implementation, some particles ... (0 likes)

View all available information about the selected experiment and...

The screenshot shows a Firefox browser window displaying the 'Library of Labs 1.5' website. The page title is 'The Double Slit Experiment' by Thomas Richter, categorized under 'Physics (Quantum physics)'. The page layout includes a navigation bar with 'Start', 'Explore', 'Contribute', 'Register', and 'Sign in'. Below the navigation bar, there is a breadcrumb trail: 'Home > Explore > Experiment Info: The Double Slit Experiment'. The main content area features a large image of a double-slit experiment showing interference patterns. To the right of the image is a 'Run the experiment' button and a descriptive paragraph: 'This experiment demonstrates refraction on waves on double slits, and interference of waves behind it. Such interference can be observed either on light waves, or even on particle waves (i.e. coherent electrons). As such, it is one of the core experiments of quantum mechanics.' On the far right, there is an 'Actions' sidebar with buttons for 'Run experiment', 'Show related material', and 'Download experiment'. At the bottom left, there is a 'Hide metadata' section listing details such as Contributors (Thomas Richter), Rights Holder (Thomas Richter), Alternative Titles (Refraction on a Double Slit), Requirements (Java Runtime Environment), Access rights (norestriction), Language ([en]), License (Creative commons: By-None Commercial - None Derivate), and Format (800x600).



...run it directly in your web browser


Since the LiLa Learning Objects are SCORM compliant, experiment packages can be integrated into online courses on compatible Learning Management Systems like ILIAS or Moodle.

Actions

- Run experiment 
- Show related material 
- Download experiment 

Opening Ilo_The Double Slit Experiment.zip

You have chosen to open

 **Ilo_The Double Slit Experiment.zip**
which is a: Compressed (zipped) Folder (-1 bytes)
from: <https://www.library-of-labs.org>

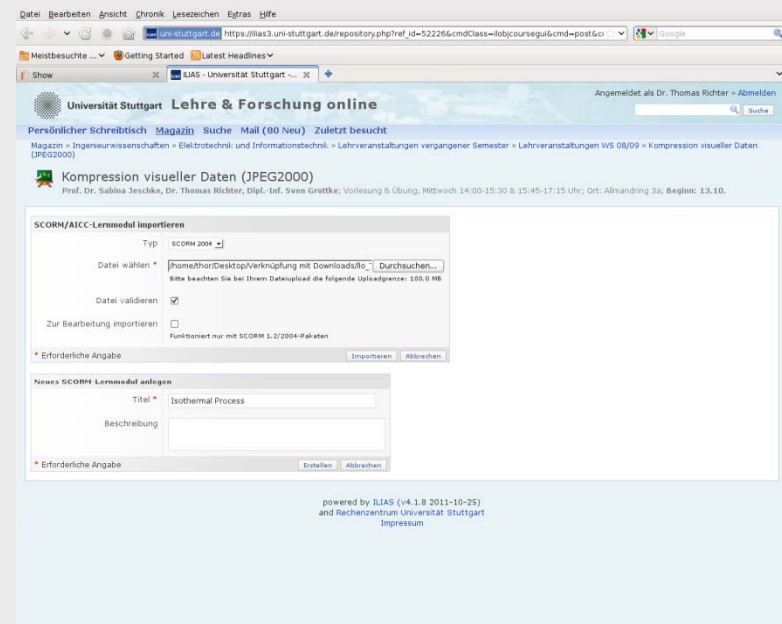
What should Firefox do with this file?

Open with **Windows-Explorer (default)**

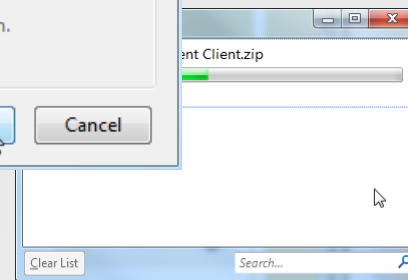
Save File

Do this automatically for files like this from now on.

OK Cancel



The screenshot shows the ILIAS website interface. At the top, it says 'Universität Stuttgart Lehre & Forschung online'. Below that, there are navigation links like 'Persönlicher Schreibtisch', 'Magazin', 'Suche', 'Mail (90 Neu)', and 'Zuletzt besucht'. The main content area displays a course titled 'Kompression visueller Daten (JPEG2000)' by Prof. Dr. Sabina Jeschke. Below the course information, there are two forms for SCORM import. The first form, 'SCORM/AICC-Lernmodul importieren', has a 'Typ' dropdown set to 'SCORM 2004', a 'Datei wählen' field with a search button, and a 'Datei validieren' checkbox. The second form, 'Neues SCORM Lernmodul anlegen', has a 'Titel' field set to 'Isothermal Process' and a 'Beschreibung' field.



The screenshot shows a file download progress bar for 'ent Client.zip'. The progress bar is partially filled with green, indicating the download is in progress. Below the progress bar, there are 'Clear List' and 'Search...' buttons.

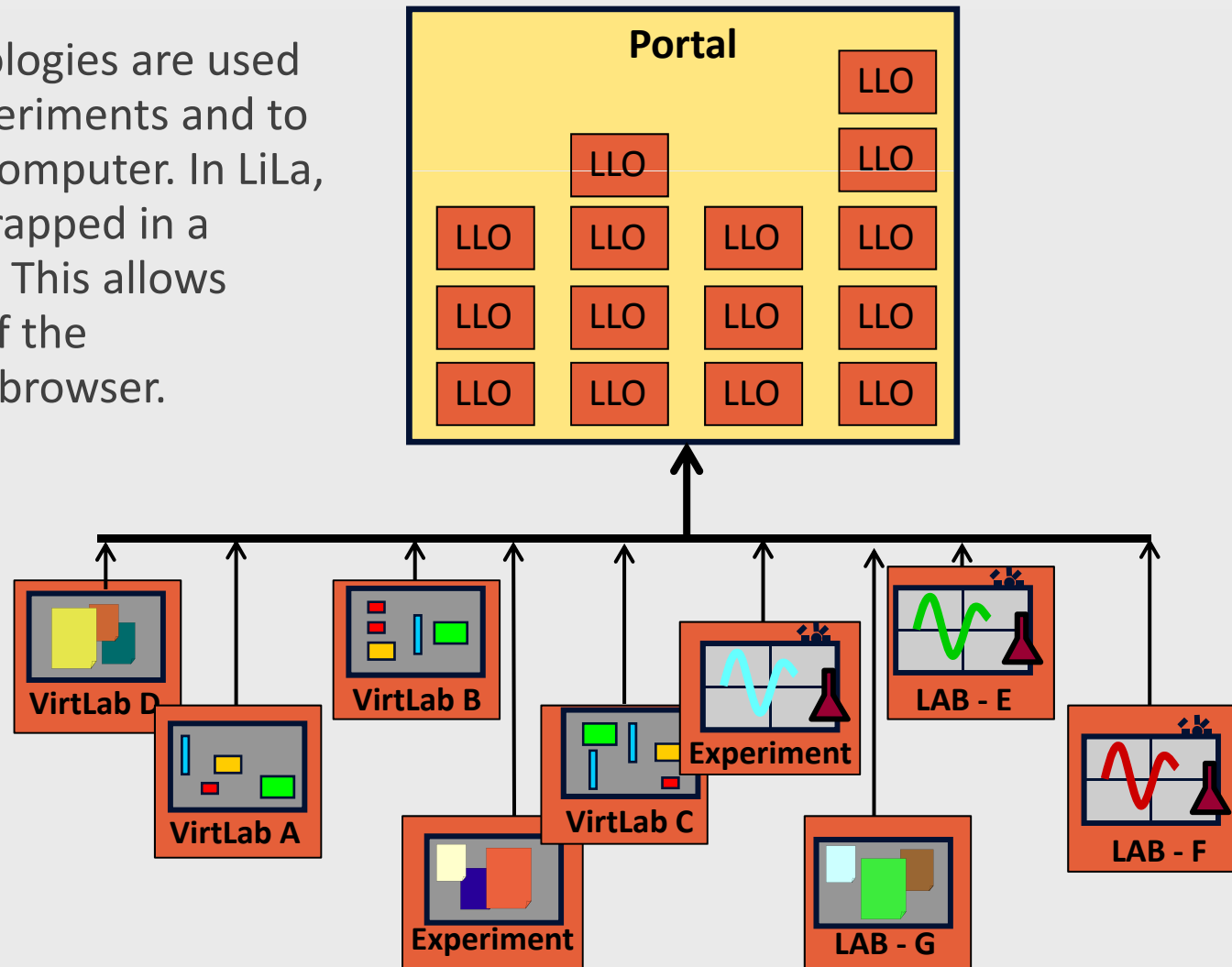
You can even upload new experiments to the LiLa repository, if you are a content provider.

The screenshot shows a web browser window with the URL `https://www.library-of-labs.org/uploadLlo/uploadAP01.action`. The page title is "Library of Labs 1.4" and the user is logged in as "Hi Thomas Richter". The navigation menu includes "Start", "MyLabs", "Explore", "Contribute", and "Logout". The breadcrumb trail is "Home > Contribute > Learning Objects > LLO".

The main content area is a form titled "Llo oscillator.zip valid" with the instruction "Please, fill in the metadata:". The form fields are as follows:

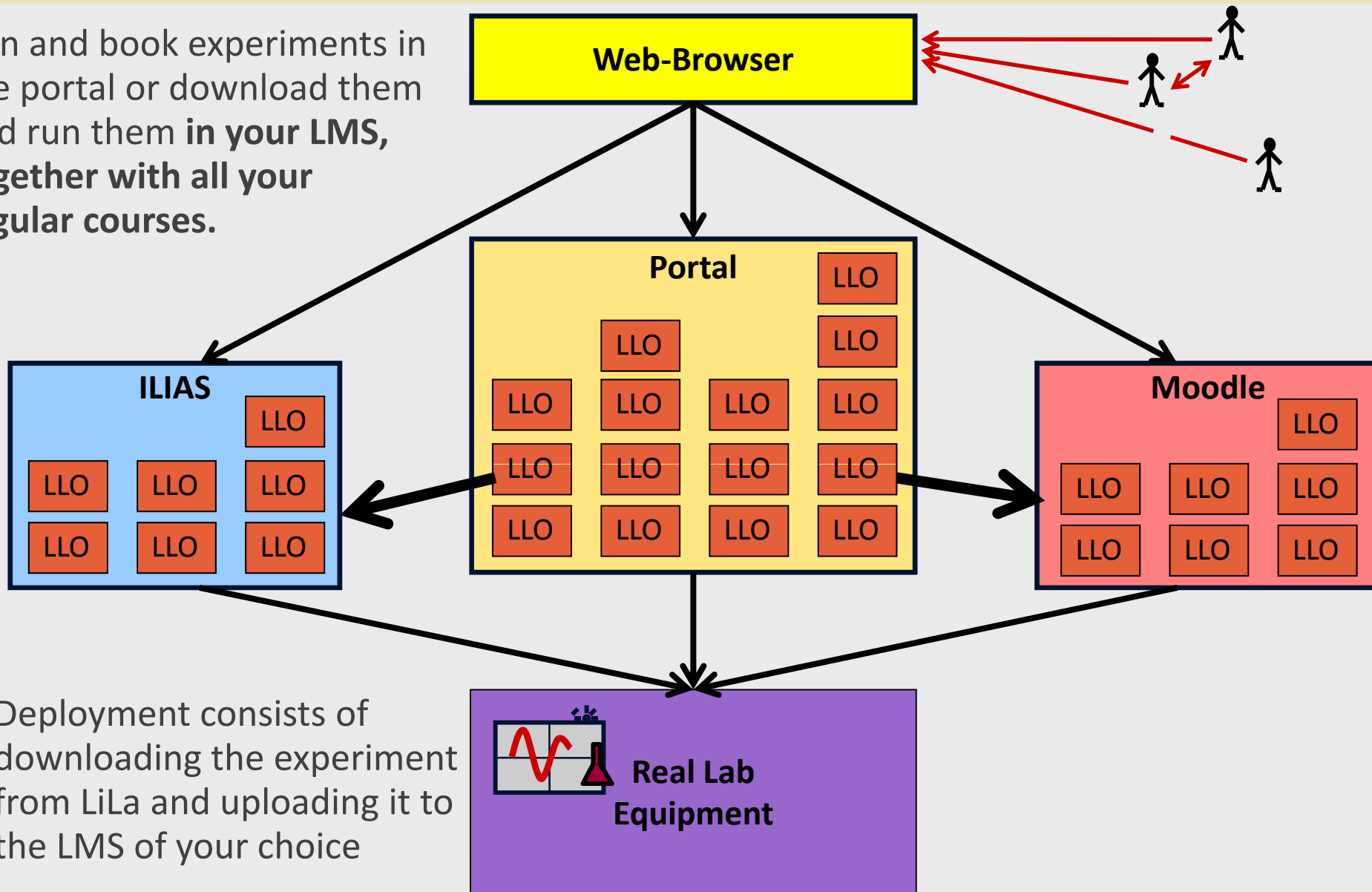
- *Title:** A text input field with a language dropdown set to "English" and a "more titles" button.
- *Description:** A large text area with a language dropdown set to "English" and a "more descriptions" button.
- Alternative title:** A text input field with a language dropdown set to "English" and a "more alternatives" button.
- *Creator:** Two radio buttons: "I created the experiment." and "One or more other persons created the experiment."
- *Language:** A dropdown menu labeled "Select Language".
- Contributor:** Two radio buttons: "I contributed the experiment." and "One or more other persons contributed the experiment."
- *Contact:** Two radio buttons: "I am the contact for the experiment." and "One or more other persons are the contact for the experiment."
- *Rights Holder:** Two radio buttons: "I am the rights holder of the experiment." and "One or more other persons are the rights holder of the experiment."
- *Access Rights:** A dropdown menu labeled "Select Access Rights".
- *License:** A dropdown menu labeled "Select License".
- *Display Size:** A text input field containing the number "2".
- **Technical requirements:** A dropdown menu labeled "Select Technical Requirements".
- *Interaction Package type:** A dropdown menu labeled "Select Type Interaction Package".
- *ScientificField:** A dropdown menu labeled "Select Scientific Field".
- Keywords:** A text input field.

Many different technologies are used to control remote experiments and to run simulations on a computer. In LiLa, all experiments are wrapped in a standardized package. This allows plug-and-play usage of the experiments in a web browser.



Central Design Goals of LiLa Software

Run and book experiments in the portal or download them and run them **in your LMS, together with all your regular courses.**



Deployment consists of downloading the experiment from LiLa and uploading it to the LMS of your choice

- LiLa enables students to find experiments and related material by indexing and cataloguing widespread resources.
- LiLa integrates experiments and labs from all over Europe, thus offering a wide and attractive choice of experiments.
- By providing access to remote and virtual experiments alike, LiLa allows students to easily compare results of simulations and real experiments side by side.
- LiLa enables the collaborate use of remote and virtual experiments, thus enhancing the student 's learning experience.

LiLa will assist lecturers in developing courses by providing:

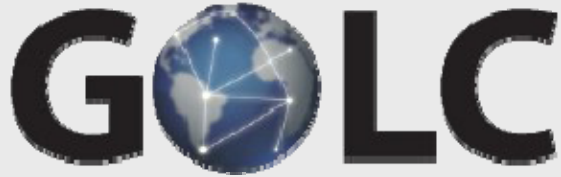
- a central starting point for finding remote experiments & virtual labs.
- supplementing material.
- didactical assistance.
- a tutoring system.
- use cases.

Lecturers can:

- offer a practical and realistic experience to more students.
- share setups and materials.

LiLa is engaged in European and international consortia to promote the development and application of remote laboratories:





The Global Online Laboratory Consortium (GOLC) is focused on promoting the development and sharing of, and research into remotely accessible laboratories for educational use.

LiLa identified interoperability of Remote Laboratories and Virtual Laboratories as important goal. This goal needs steps towards standardization and can only be reached on a global level.

LiLa contributions to work in GOLC sub committees:

- Technical Metadata for cross-system retrieval (Technical Committee)
- Regulations for cross-system booking (Technical Committee)
- Structured descriptions of pedagogical settings (Pedagogical Committee)
- Pedagogical Metadata (Pedagogical Committee)
- Standard Questionnaire for Evaluation (Pedagogical Committee)



SEFI, the European Society for Engineering Education, has more than 150 university members from 27 countries across Europe.

LiLa partners will continue to collaborate as Working Group within SEFI.

Topics will be

- Promotion of re-usage of existing content
- Exchange of usage experiences
- Work on pedagogical scenarios
- Maintenance of the portal
- Inclusion of additional content

Everybody is invited to join!

LiLa is designed for participation.

Students and teachers can visit the LiLa Portal at any time, search for experiments and run them on the portal or download them to their local Learning Management Systems. Some remote experiments need a booking: LiLa will provide contact information to the owner of the content and a booking system.

Moreover, LiLa is designed for integrating additional content – virtual laboratories and remote experiments. In fact, more than 100 experiments on the LiLa portal were provided by partners from outside the original consortium.

Interested parties are welcome to contact LiLa at any time.

LiLa Portal: <http://library-of-labs.org>

Project Website: <http://www.lila-project.org>

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